DEAR Technical Note IR-5

The DEAR Slow Monitor and Control System

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1 Introduction

There are several variables associated with the DEAR setup that should be measured over time, specifically

- Target temperature and pressure
- CCD temperatures
- CCD isolation vacuum
- Saftey valve position
- Calibration source position

Each of these variables represents a quantitiy whose stability is essential for the safe and continous operation of the experiment, and whose time scale for fluctuations is on the order of seconds or minutes, and thereby only need to be monitored on a "slow" basis. The target density, reflected in the correlated pressure and temperature, must be maintained in order to insure that the kaon stopping distribution remains centered on the CCD windows. The CCD temperatures must be maintained below 180 K in order to limit the intrinsic dark current in the detectors. Should this current be too high, our pedestal (the "noise peak") would be correspondingly high, pushing the Zirconium calibration peak off the end of our observable energy range. The CCD isolation vacuum is essential in order to maintain the CCD temperatures, and to prevent the build-up of ice on the chip surfaces, which would decrease the detection efficiency and damage the chips. The "saftey valve" listed above refers to the gate valve separating the turbo-molecular pump from the isolation vacuum volume. In the event of a pump failure, this valve should close in order to maintain the isolation vacuum until the CCD temperature can be raised and/or the pump can be repaired. Finally, it is of course necessary to monitor the position of the calibration source; any signal from kaonic hydrogen would be completely overwhelmed if the source were inserted during normal data acquisition.

In addition to the above quantities that should be monitored over time, there are two items that one would also like to control on a slow (on the order of seconds) basis: the calibration source motion, and the "Alimentation" power supply of Command Box v1 (the original JUMBO I command box system). The necessity of calibration source control is clear, and is described and justified elsewhere, but the necessity of the control of the Command Box power supply is perhaps not so obvious. Such control is required because the original Command Box can only recover from certain failure modes through a hardware reset of the box, which in turn can only be accomplished by toggling the main power.

The abovementioned monitor and control issues have been addressed by a combination of hardware and software which are generally referred to as the *Slow Monitor*, but should more precisely be referred to as the *Slow Monitor and Control System*, or *SMACS*, which is the subject of this report. The designations SMACS and Slow Monitor will be used interchangeably in this report.

The remainder of this report is divided in to two sections, one containing a description of the SMACS hardware and one containing a description of the SMACS software. Details concerning the setup and installation of the Slow Monitor can be found in Appendix A. Schematics of the various custome SMACS components can be found in Appendix B.

2 SMACS Hardware

The SMACS requires two personal computers (henceforth referred to as PCs) running Windows 95 or Windows NT with network (Ethernet) capabilities. In addition, the SMACS relies on the following commercial hardware from National Instruments:

- GPIB PC AT-bus card
- AT-MIO-16 PC AT-bus card
- PC-TIO-10 PC AT-bus card
- SMD-2042-RTD interface card

GPIB is the colloquial name for the IEEE standard 488.2 interface, which is built in to many commerical instruments. The AT-MIO-16 card contains an 8-channel analog-to-digital converter (ADC) and allows for 8 bits of digital input, 8 bits of digital output, and a 32-bit counter. The PC-TIO-10 has 8 16-bit counters (which can form 4 32-bit counters) and two timing channels. The SMD-2042-RTD is an interface card for the AT-MIO-16 that also contains amplifiers and precision current sources, which allow direct measurements of devices such as the PT-100 thermoresistors, which are used to monitor the CCD temperatures.

To supplement the above commercial hardware, we have built the following custom control and interface boxes:

- Power Control Box
- Source Control Box
- Switch Control Box
- PC-TIO-10 Interface Box
- SC-2042-RTD Interface Box

The Power Control Box contains three logic-switched 220-Volt relays and a 24 volt power-supply. The Source Control Box contains a single logic-switched 24-Volt relay for controlling the calibration source motion pneumatic valve (the 24 Volts being supplied by the Power Control Box). The Switch Control Box supplies a logic signal (3.6 Volts), also derived from the 24 Volts originating in the Power Control Box, for the digital inputs of the Slow Monitor. The two Interface Boxes provide standard LEMO connectors for the inputs of the SC-2042-RTD and the PC-TIO-10.

The relationship between these commercial and custom hardware modules, and the overall pattern of data flow for the SMACS is shown schematically in Figure 1.

The PC located in the counting room, (referred to as the *Receiver*, for reasons that will become obvious in the Software section) is equipped with the PC-TIO-10 card. The Receiver is connected to the PC-TIO-10 Interface Box with a National Instruments type NB1 ribbon cable. The Interface Box has three LEMO inputs for Kaon Monitor signals: Inner (signals above threshold from the scintillator on the inside of the DAΦNE ring), Outer (signals above threshold from the scintillator on the outside of the DAΦNE ring), and Kaon (coincidence signals above threshold from the two scintillators). These inputs are derived from the NIM electronics of the Kaon Monitor, which is described elsewhere. Note that some of the outputs of the PC-TIO-10 channels are chained to the inputs of subsequent channels in order to form 32-bit counters. Note also that when the drivers for the PC-TIO-10 are installed, the card must be given a **Device Number** of **1** in order to properly interface with the SMACS software.

The PC located in the experimental area (henceforth referred to as the *Server*) is equipped with the GPIB and AT-MIO-16 cards.

The GPIB card is directly connected with a I488.2 standard cable to a Lakeshore model 330 Temperature Controller, which is used to stabilize the target temperature to within 0.2 K. Through this connection, the Server can read the temperature sensors mounted at two points on the APD compressor cold finger. The relationship between these two temperatures and the true target temperature must be established experimentally, using the vapor pressure curve of hydrogen (refer to the description of the cryogenic target system presented elsewhere), but for the purpose of the Slow Monitor, it suffices that these temperatures are directly correlated with the target

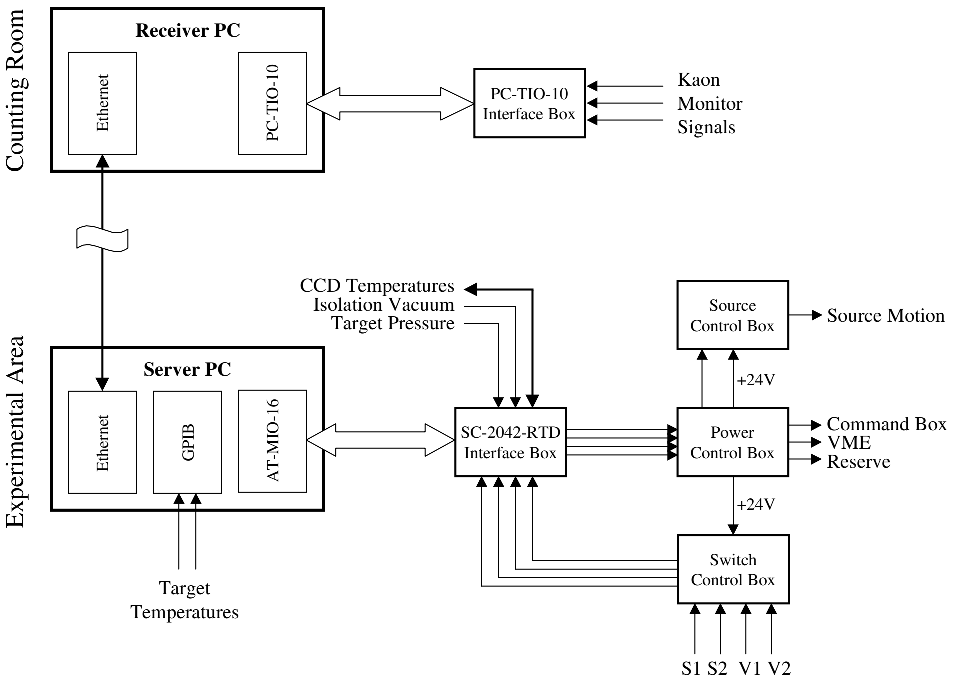


Figure 1: Schematic representation of the SMACS hardware.

temperature. Note that the **GPIB address** of the Lakeshore 330 unit must be set to **12** in order to properly interface with the SMACS software.

The AT-MIO-16 card is connected to the SC-2042-RTD Interface Box with a National Instruments type NB4 shielded ribbon cable. This Interface Box is in turn connected (with a custom cable) to 4 PT-100 thermoresistors, one on each CCD housing cold finger (that is, one for each pair of CCD chips). The SC-2042 itself supplies the constant current necessary to measure meaningful voltages from the PT-100 thermoresistors, which are directed to the ADC channels of the AT-MIO-16 card. Two additional voltages are shunted directly to the AT-MIO-16; one from the WIKA Tronic Line pressure gauge, which monitors the target cell pressure, and one from the Varian CC2C vacuum gauge, which monitors the CCD isolation vacuum. The conversion of these voltages into temperatures and pressures is discussed in the Software section. Note that when the drivers for the AT-MIO-16 are installed, the card must be given a **Device Number** of **1** in order to properly interface with the SMACS software.

In addition to the six analog inputs to the SC-2042-RTD Interface Box described above, there are four digital inputs and four digital outputs. The four digital inputs are logic signals that indicate the state of four switches, S1, S2, V1, and V2. The four switches are not directly connected to the Interface Box, but rather, are connected to the Switch Control Box, which delivers a logic signal (+3.6 V) to the Interface Box when the given switch is closed. The Switch Control Box requires a +24 Volt input from the Power Control Box.

The switches are defined as follows: When the calibration source is withdrawn, switch S1 is closed and switch S2 is open. When the calibration source is inserted, switch S2 is closed and switch S1 is open. Any other configuration is considered to be an error state. Similarly, when the saftey gate valve connecting the turbomolecular pump to the CCD isolation vacuum is open (withdrawn), switch V1 is closed and switch V2 is open. In the case of vacuum failure, this valve automatically closes, and switch V1 is open and switch V2 is closed. Again, any other configuration is considered to be an error state.

The four digital outputs of the Interface Box are directly connected to the Power Control Box. Three of these outputs (labelled *Command Box*, *VME*, and *Reserve*) control current flow to the three similarly labelled 220 VAC plugs mounted on the Power Control Box. When the respective digital bits are set high, the corresponding plug receptacle can deliver power. The fourth output (labelled *Source*) is simply shunted through the Power Control Box to the Source output, which is in turn connected to the Control input of the Source Control Box (it would also be possible to directly connect the Source output of the Interface Box to the Control input of the Source Control Box; this is merely a question of aesthetics and cable lengths).

The hardware interconnections described above and illustrated in figure 1 are summarized in tables 1 through 7.

Label	Connector	Cable	Source or Destination
AT-MIO-16	50-pin	NB4	SC-2042-RTD Interface Box
GPIB	GPIB	I488.2	Lakeshore 330 Controller

Table 1: Connections for the Server PC

Label	Connector	Cable	Source or Destination
PC-TIO-10	50-pin	NB1	PC-TIO-10 Interface Box

Table 2: Connections for the Receiver PC

Label	Connector	Cable	Source or Destination
24 V	LEMO	LEMO	Power Control Box: 0-24 V (teed)
Control	LEMO	LEMO	Power Control Box: Source(Out)
I	LEMO	custom LEMO	Source Motion Pneumatic Valve I
II	LEMO	custom LEMO	Source Motion Pneumatic Valve II

Table 3: Connections for the Source Control Box

Label	Connector	Cable	Source or Destination
In: 1	LEMO	LEMO	Kaon Monitor: Coincidence
In: 3	LEMO	LEMO	Kaon Monitor: Inner Scintillator
In: 6	LEMO	LEMO	Kaon Monitor: Outer Scintillator
Out:1	LEMO	LEMO	PC-TIO-10 Interface Box: In: 2
Out:3	LEMO	LEMO	PC-TIO-10 Interface Box: In: 4
Out:6	LEMO	LEMO	PC-TIO-10 Interface Box: In: 7

Table 4: Connections for the PC-TIO-10 Interface Box

Label	Connector	Cable	Source or Destination
V1	LEMO	LEMO	Switch Control Box: V1
V2	LEMO	LEMO	Switch Control Box: V2
S1	LEMO	LEMO	Switch Control Box: S1
S2	LEMO	LEMO	Switch Control Box: S2
Target Pressure	LEMO	custom LEMO	WIKA: pin 8 of 9 (signal) WIKA: pin 6 of 9 (ground)
Isolation Vacuum	LEMO	custom LEMO	Varian CC2C: IG REG
Reserve	LEMO	LEMO	Power Control Box: Reserve
Source	LEMO	LEMO	Power Control Box: Source(In)
VME	LEMO	LEMO	Power Control Box: VME
Command Box	LEMO	LEMO	Power Control Box: Command Box
CCD-Temperature Sensors	DB-25	custom	JUMBO I,A,B,C: 20-pin LEMO plug

Table 5: Connections for the SC-2042-RTD Interface Box

Label	Connector	Cable	Source or Destination
INPUT: 24 V	LEMO	LEMO	Power Control Box: 0-24 V (teed)
INPUT: V1/2	4-pin Burndy	custom	Safety Valve Switches
INPUT: S1/2	4-pin Burndy	custom	Source Motion Switches
OUTPUT: V1	LEMO	LEMO	SC-2042-RTD Interface Box: V1
OUTPUT: V2	LEMO	LEMO	SC-2042-RTD Interface Box: V2
OUTPUT: S1	LEMO	LEMO	SC-2042-RTD Interface Box: S1
OUTPUT: S2	LEMO	LEMO	SC-2042-RTD Interface Box: S2

Table 6: Connections for the Switch Control Box

Label	Connector	Cable	Source or Destination
Reserve	LEMO	LEMO	SC-2042-RTD Interface Box: Reserve
Source(In)	LEMO	LEMO	SC-2042-RTD Interface Box: Source
VME	LEMO	LEMO	SC-2042-RTD Interface Box: VME
Command Box	LEMO	LEMO	SC-2042-RTD Interface Box: Command Box
0-24 V	LEMO (teed)	LEMO	Switch Control Box: 24 V Source Control Box: 24 V
Source(Out)	LEMO	LEMO	Source Control Box: Control

Table 7: Connections for the Power Control Box

3 SMACS Software

The SMACS software is based on the National Instruments **LabVIEW** graphical programming language and interface. The software was developed using the full LabVIEW development system, and the final stand-alone executables were created using the LabVIEW Application Builder.

There are two stand-alone applications, one called the *Server*, running on the Server PC in the experimental area, and one called the *Receiver*, running on the Receiver PC in the counting room.

The Server program collects data from the GPIB and AT-MIO-16 cards, makes the necessary conversions, and displays the data in numerical and graphical formats. Most importantly, the Server process makes this data available over the local network using the Windows standard NetDDE protocol. The Server routine must be running in order for data to be available on the Receiver PC in the counting room.

The Receiver program collects the data broadcasted by the Server and displays it in similar numerical and graphical formats. In addition, the Receiver process reads the Kaon Monitor data from the PC-TIO-10 card in the Receiver PC.

Both programs are capable of storing data to a local hard drive. However, the Server process does not have access to the Kaon Monitor data read by the Receiver and thus files stored on the Server PC will include no luminosity data.

3.1 The Server Program

The Server is started by clicking on the Server icon on the Windows 95 desktop of the Server PC. The program runs immediately upon startup.

A LabVIEW control panel consists of four main object types: controls, indicators, displays, and decorations. We will ignore the decorations (borders, text boxes, etc.) and begin by describing the various indicators found on the Server control panel:

Jumbo I/A/B/C: The readings from the PT-100s on the four cold-fingers (corresponding to the CCD vacuum housings labelled **Jumbo I**, **Jumbo A**, **Jumbo B**, and **Jumbo C**) are converted to degrees Kelvin and displayed in this box. The conversion is based on standard PT-100 voltage (V) vs. temperature (T) curves, fit by the following polynomial:

$$T = 29.4495 + 2309.2 \cdot V + 1268.7 \cdot V^2$$

These temperatures are systematically high by about five degrees at room temperature, but are accurate to ± 1 degree at 160 K.

Pressure(chart): The monitor voltage from the Trioc Line pressure gauge is converted into pressure and displayed in this box. The conversion was determined empirically and is given by

$$P = (V - 2.00)/0.8$$

where P is the pressure in bar and V is the monitor output in volts. This display is only accurate to $\pm$ 10%.

Isolation Vacuum: The monitor voltage from the Varian CC2C vacuum gauge is converted into pressure and displayed in this box. The conversion was determined from the calibration curves given in the Varian CC2C manual, and is taken as

$$P = 10^{(1.174 \cdot V - 11.69)}$$

where P is the pressure in Torr and V is the monitor output in Volts. This display is only accurate to within a factor of two (which is adequate since we are only interested in the order of magnitude of the isolation vacuum).

Gate Valve: This button indicates the state of the sense switches of the isolation vacuum safety gate valve. If switch V1 is closed and switch V2 is open, the valve is shown to be open. If switch V1 is open and switch V2 is closed, the valve is shown to be closed. Other states (both switches open or both switches closed) are considered error states and the **error** light next to this button will turn red.

Temperature: These temperatures are read directly from the Lakeshore 330 Temperature Controller. The conversion takes place in the Lakeshore unit and the temperatures are accurate to within 0.2 K. However, these temperatures are not direct measures of the target temperature, but instead are related to the target temperature by a constant offset (due to the temperature gradient along the APD compressor cold finger). Note that a temperature readout of zero indicates that the Lakeshore controller is not turned on.

Calibration Source Status: These "lights" indicate the state of the sense switches on the calibration source motion. If switch S1 is closed and switch S2 is open, the source is shown to be in the **OUT** position. If switch S1 is open and switch S2 is closed, the source is shown to be in the **IN** position. Other states (both switches open or both switches closed) are considered error states and the **Error** light will turn red.

Running: If the Server program is running, this square "light" will be green, otherwise it is grey.

Next, we describe the various controls on the Server control panel:

Start Arrow: This is an unlabelled arrow on the left end of the white control bar on the top edge of the control panel. When the arrow is black, the Server is running; when it is white (with a black border), the Server is stopped. The Server is running upon start-up. In order to stop the Server, click on the **STOP?** button (described below). To re-start the Server, click on the **Start Arrow**.

Remote Control: When this button reads **Enabled**, the scan rate is set by the Receiver program. Also, the digital outputs (**Source**, **VME**, **Command Box**, and **Reserve**) are controlled by the Receiver PC. Thus, during normal running conditions, it is very important that **Remote Control** is **Enabled** on the Server program before leaving the experimental area. For local tests, **Remote Control** can be **Disabled**, allowing for local control of the scan rate, calibration source motion, etc..

Remote Scan Rate: This indicates the rate at which the input devices will be polled and the displays will be updated. This rate is controlled by the Receiver PC. Note that all Server tasks are effectively suspended during the dead time defined by the scan rate, which means that although controls can be manipulated, no action will be taken until the end of the present wait cycle. It is therefore undesirable to set the scan rate too high; for example, if this rate were set to ten minutes, it would take up to ten minutes to change any variable, including the calibration source position or the scan rate itself! The recommended scan rate is five or ten seconds.

Local Scan Rate: This is the same as **Scan Rate** described above, but it is set by the Server PC rather than the Receiver. In order for this rate to be effective, **Remote Control** must be **Disabled**.

STOP?: This button can be used to gracefully exit the Server routine, which is particularly important if files are being written. Note that it will take up to 2 x (Scan Rate) seconds for the routine to fully stop. During the interim, the **STOP?** button reads **STOPPING**. The Server has halted when the **Running** light is off (grey rather than green). To restart the program, click on the arrow in the upper left corner of the control screen. The Server routine can also be closed by choosing *Exit* from the File Menu, or by clicking the close box in the upper right corner of the panel, but this is not recommended until the process has been fully stopped using the **STOP?** button.

Source/Command Box/VME/Reserve: These four buttons control the digital outputs of the AT-MIO-16, which in turn control the calibration source motion and the power to the Command Box, VME crate, and one reserve channel. Note that Remote Control must be disabled in order for these buttons to have an effect; otherwise, the state of the digital outputs is controlled by the Receiver PC.

Save Local: If this button reads **Yes**, Server data is written to the file indicated in the File Path display. If no file has been designated, a file dialog box will appear when the button is pressed. Note: the response time of this button can be very long (**Scan Rate** x **Save Every #**)!

The Server data is written in a simple text format that can be directly imported to spreadsheets or other programs. Within the file, the data appear on a single line, one line per write operation, in the following order:

Time	*Date*	*TargetTempA*	*TargetTempB*
CCDTempI	*CCDTempA*	*CCDTempB*	*CCDTempC*
TargetPressure	*IsolationVacuum*	*DigitalWord*	

The *DigitalWord* is a decimal number whose binary representation corresponds to the following switches:

Bit	3	2	1	0
Input	V2	V1	S2	S1

New File?: Press this button in order to change the file to which data is saved. This button only has an effect if the **Save Local** button is set to **Yes**.

Save Every #: This number controls the scale factor between the data polling rate and the data writing rate. For example, if the scan rate is set to 5 seconds, and **Save Every #** is set to 3, then data will be written to the selected file every 15 seconds. This button is useful, for example, when you want the screen to update frequently (and have faster response time of the program) but also want to save disk space by writing data less often.

C/K: This switch toggles the units of the target temperature displays between Celsius and Kelvin. Note that the units on the Lakeshore 330 display itself are also controlled by this switch.

Indicator Thresholds: Each of the analog channels (the CCD temperatures, the target temperatures, the isolation vacuum, and the target pressure) has a corresponding digital display, with an indicator "light" to the right of the display. If the value of the display is between the indicator thresholds set at the bottom of the control display (you have to scroll to see them), the light will be green; otherwise the light will be red, indicating that the parameter is outside of its acceptable range. These threshold values should only be altered for testing purposes or after hardware changes.

In addition to the controls and indicators described above, there are also displays (graphs, or "charts") on the typical LabVIEW panel. In a stand-alone LabVIEW Application, there are a few aspects of these charts that can be controlled by clicking on the chart with the right mouse-button. The important controls for the DEAR user are *Clear Chart* and *Autoscale Y*. The function of *Clear Chart* should be obvious. If *Autoscale Y* is selected (a check mark appears next to this option), the Y scale automatically adjusts to the data range. However, it may be more interesting to fix the Y scale (to observe the CCD temperature on a range from 160 K to room temperature, for example), in which case *Autoscale Y* should be deselected. The Y scale can then be adjusted by directly editing the scale with the mouse (for highlighting) and keyboard (for input). The other chart controls should probably be left at the default values (*Autoscale X*, for example, should remain selected).

The two main displays on the Server control panel are:

CCD Temperatures: This chart shows a time history of the four CCD cold-finger temperatures. The Y scale is in degrees Kelvin. The X scale does not indicate time, but rather "number of read cycles," and is not particularly meaningful.

Target Pressure: This chart shows a time history of the target pressure. The Y scale is in bar. The X scale does not indicate time, but rather "number of read cycles," and is not particularly meaningful.

3.2 The Receiver Program

The Receiver is started by clicking on the Receiver icon on the Windows NT desktop of the Receiver PC. The program runs immediately upon startup.

The indicators of the Receiver program are essentially identical to those of the Server program, except that they are not necessarily in the same place. There are, however, the following additional indicators:

Kaon Counts: This is the number of counts presently read from the first 32-bit counter of the PC-TIO-10, which should be connected to the coincidence output of the Kaon Monitor system.

Counts Inner: This is the number of counts presently read from the second 32-bit counter of the PC-TIO-10, which should be connected to the signal-above-threshold output of the Kaon Monitor scintillator on the inner side of the storage rings.

Counts Outer: This is the number of counts presently read from the third 32-bit counter of the PC-TIO-10, which should be connected to the the signal-above-threshold output of the Kaon Monitor scintillator on the outer side of the storage rings.

The controls of the Receiver program are essentially identical to those of the Server program, except that they are not necessarily in the same place, there is only a single **Scan Rate** control, and there is no **Remote Control** button. Nevertheless, it is required that the **Remote Control** button of the Server to be set to **Enabled** for some of the controls on the Receiver to have an effect; specifically, the **Source**, **VME**, **Command Box**, and **Reserve** buttons.

There also exist the following additional displays on the Receiver panel:

Kaon Monitor Rate: The approximate Kaon rate, in Hertz, is displayed digitally and on a logarithmic bar graph. This rate is calculated by noting the counts C_1 of the first 32-bit counter at some time T_1, then again the counts C_2 at some later time T_2. The rate R is simply given by

$$R = (C_2 - C_1)/(T_2 - T_1).$$

Note that the accuracy of this rate will depend on the size of the time interval $T_2 - T_1$, and the accuracy to which this interval is measured, which will in turn depend upon the other demands of the Receiver CPU. For this reason, among others, the Receiver PC should be used for only two processes, the Receiver program itself, and the terminal program used to control the Kaon Monitor phototube power supplies.

It should also be noted that the significance of this calculated kaon rate will depend on the absolute rate (which should be greater than 1 Hz for a meaningful measurement) and the stability of the accelerator.

Kaon Rate Time History: This chart shows a time history of the Kaon Monitor Rate. The Y scale is in Hertz. The X scale does not indicate time, but rather "number of read cycles," and is not particularly meaningful.

In addition to the differences described above, the format of data written by the Receiver program is different from that of the Server program, since the Kaon Monitor data is also included. Within the file, the data appear on a single line, one line per write operation, in the following order:

Date	*Time*	*TargetTempA*	*TargetTempB*
CCDTempI	*CCDTempA*	*CCDTempB*	*CCDTempC*
TargetPressure	*IsolationVacuum*	*DigitalWord*	
KaonCounts	*KaonRate*	*CountsInner*	*CountsOuter*

Note that the order of Date and Time have been puposefully inverted, so that Receiver data files can be immediately distinguished from Server data files. Also, the format of the *DigitalWord* is the same as that in the Server data.

Appendix A

This Appendix deals with some of the more technical aspects of the Slow Monitor installation. Note that the Windows 95 system running on the Server PC is in German and the German equivalent commands are shown in *italics*.

Creation of a Local Network

The Server and Receiver PCs should form an isolated network, so that the processes cannot be disturbed by network traffic or other activities. The data files are small enough to transfer with 3.5" diskettes.

- The two PCs should be connected by a BNC cable, with a BNC-T with 50-Ohm termination on both ends.
- Start the program Network (*Netzwerk*) in the **Control Panel** (*Systemsteuerung*) folder.

  Under Identification (*Identifikation*), the Computer Name (*Namen*) and Workgroup (*Arbeitsgruppe*) must be set. The Server and Receiver must have different names but should be part of the same workgroup.
- The computer must be restarted for these changes to take effect.

This procedure must be followed on both computers.

NetDDE (Dynamic Data Exchange)

In order to facilitate communication between computers, LabVIEW offers the so-called DDE vi's (**v**irtual **i**nstruments). Using these subroutines and the DDE protocol, it is possible to exchange data between to simultaneously running programs.

In order to allow data exchange over a local network, the program **NetDDE.exe** must be started each time the computer is booted. For this reason, it is useful to place this application in the Autostart folder.

- Click on the task-list (the bar at the bottom of the screen) with the right mouse-button and open the **Properties** (*Eigenschaften*).
- Select **Start Menu Programs** (*Programme in Menustart*).

- Click **Add...** (*Hinzufügen*) and select one of the following path names:

Computer:	Command Line:
Server	C:/windows/netdde.exe
Receiver	C:/Winnt/system32/Netdde.exe

- Click Next, then double-click on the Start *Autostart* folder, then click Finish.

This procedure must be followed on both computers.

Server Setup

The following procedure is for the Server PC only.

In the Server program, the data is directed by a "key" within the NetDDE process, which the client can also access with its NetDDE program. This key must be written in to the **Regedit** file (found in the Windows folder) using the LabVIEW program **Register NetDDE Server.vi**. Using this program, the Local Server name "TestServer" and the Topic "lvdemo" should be given in the appropriate fields. The name "TestServer" should also be given in the Application field. This program needs to be run only once.

It is furthermore necessary to add the following line to the [DDEShares] section of the "system.ini" file (in the Windows) folder:

lvdemo=TestServer,Chart,,31,,0,,0,0,0

Decimal Place Marker

It is important that both the Server and the Receiver computers on the local network are using the same decimal place marker (**,** or **.**). This attribute can be set in the the **Control Panel** (*Systemsteuerung*) folder under **Regional Settings** (*Ländereinstellungen*).

Appendix B

This Appendix contains circuit diagrams and cable specifications for various Slow Monitor components.

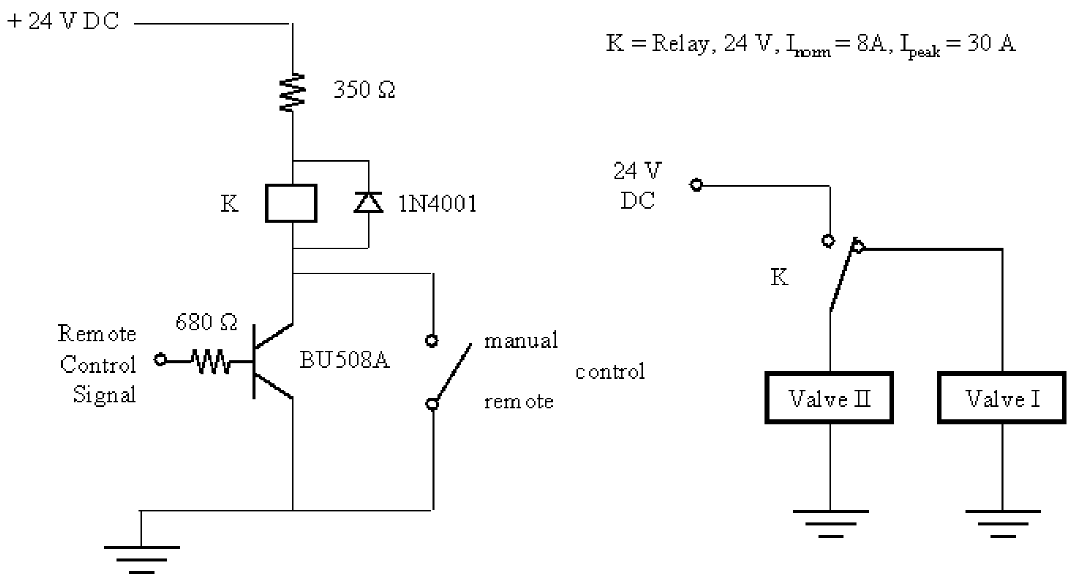


Figure 2: Schematic diagram of the Source Control Box.

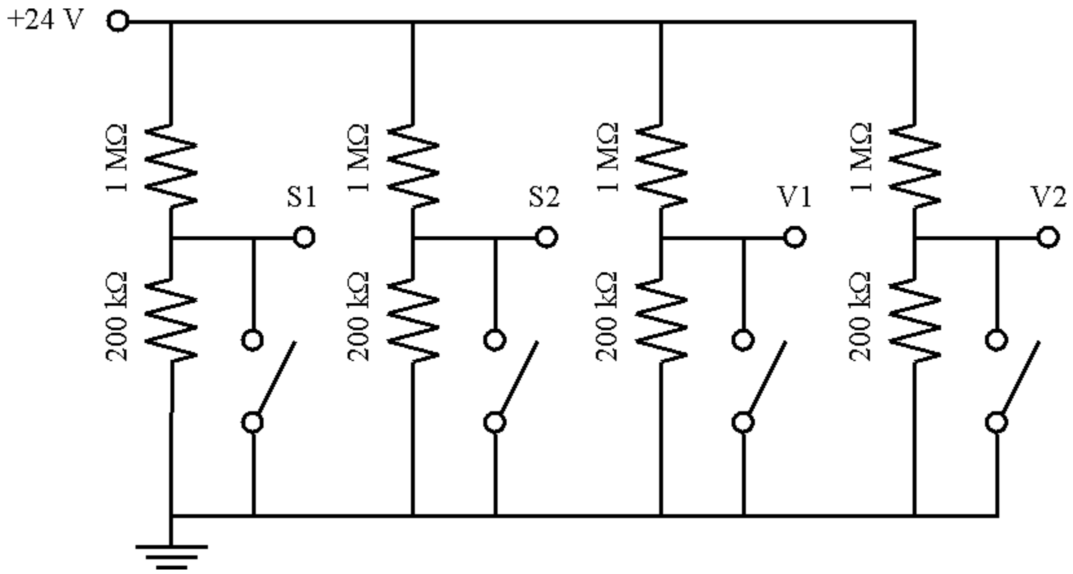


Figure 3: Schematic diagram of the Switch Control Box.

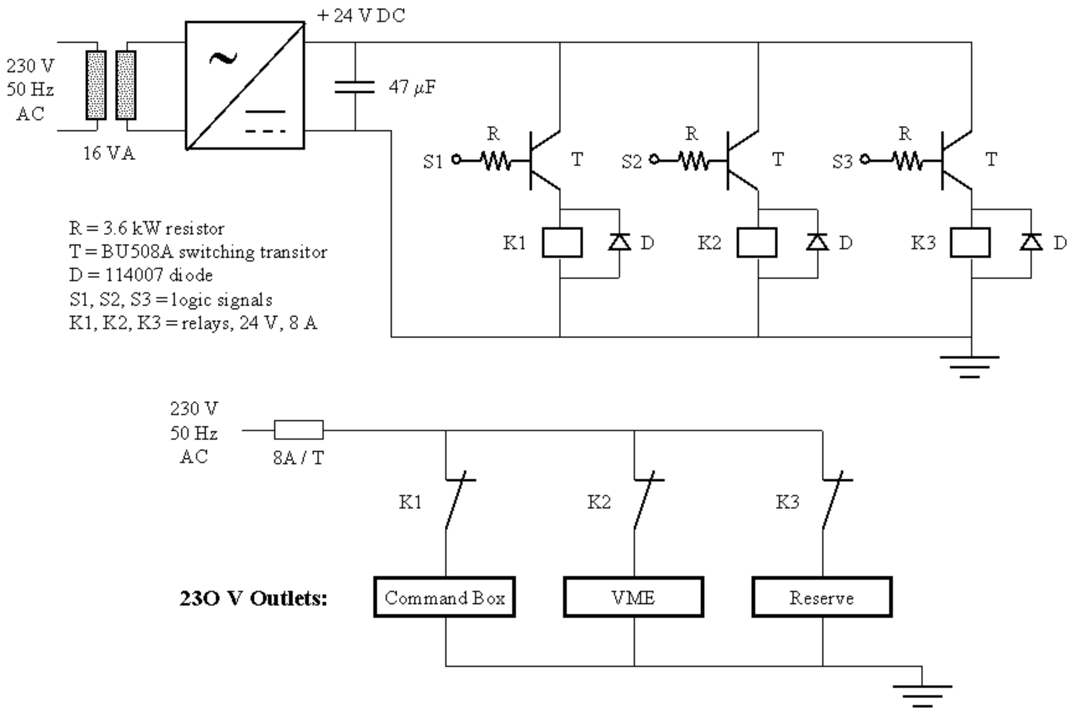
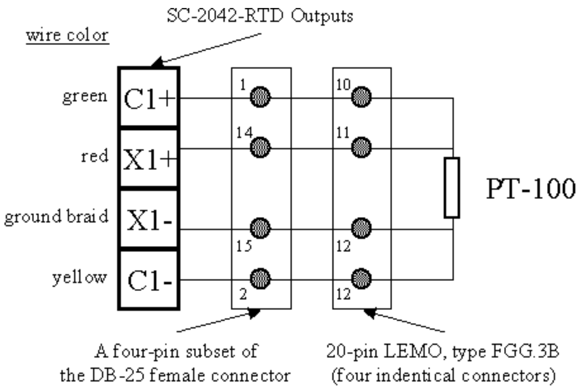


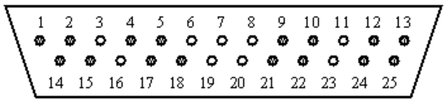
Figure 4: Schematic diagram of the Power Control Box.



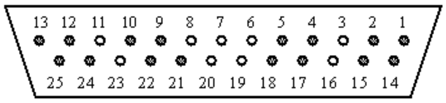
(A) Connections between the DB-25 and LEMO connectors of the Temperature Monitor Cable

Channel	C1+	X1+	X1-	C1-
JUMBO I	1	14	15	2
JUMBO A	4	17	18	5
JUMBO B	9	21	22	10
JUMBO C	12	24	25	13

(B) Table of connections between the SC-2042-RTD and the DB-25 receptacle



(C) DB-25 Male Connector
[as seen from the solder-point side]
SC-2042-RTD Interface Box Receptacle



(D) DB-25 Female Connector
[as seen from the solder-point side]
Temperature Monitor Cable Connector

Figure 5: Specification of the CCD temperature monitor cables.